INDEX TO VOLUME 133

Abilities of the 200-Inch Telescope To Discriminate between Selected World Models (Sandage), 355.

Absolute *f*-Value of the Pb I Line λ 2833 (Bell and King), 718.

Abt, H. A. Frequency of Binaries among Metallic-Line Stars, 730.

Abt, H. A. Radial Velocities of Three Metallic-Line Stars, 910.

Abundance Analysis of R Coronae Borealis (Searle), 531.

Abundance of Beryllium in Four Stars of Type A (Bonsack), 551.

Abundance of Lithium in T Tauri Stars: Further Observations (Bonsack), 340.

Abundances in G Dwarf Stars. IV. A Redetermination of the Abundances in G Dwarfs in the Hyades (Parker, Greenstein, Helfer, and Wallerstein), 101.

Abundances in G Dwarfs. V. The Metal-rich Star 20 Leo Minoris and Two Comparison Stars (Wallerstein and Helfer), 562.

Accurate Partition Functions in the Determination of the C_2 Abundance (Clementi), 303.

Akabane, K., and Cohen, M. H. Polarization Measurements of Type III and Faraday Rotation in the Corona, 258.

Alfvén, H. Origin of Cosmic Magnetic Fields, 1049.

Amplification of the Poloidal Magnetic Flux in a Plasma (Lindberg and Jacobsen), 1043.

Analysis of the Absolute Energy Distribution in the Spectrum of Eta Aquilae (Oke), 90.

Analysis of R. A. Lyttleton and H. Bondi's Theory of "The Physical Consequences of a General Excess of Charge" (Swann), 738.

Ananthakrishnan, R. Distribution of Heights of Prominences, 969.

Area-Intensity Integrator for Solar Flares (Feibelman), 269.

Arp, H. Supernova in NGC 7331, 883.

Arp, H. Transformation of Photographic Magnitudes, 869.

Arp, H. $U - B$ and $B - V$ Colors of Black Bodies, 874.

Arp, H. C., and Kraft, R. P. Comparison of Cepheids in the Small Magellanic Cloud with Those in the Vicinity of the Sun, 420.

Athay, R. G. *See* House, Athay, and Zirin.

Athay, R. G., and Moreton, G. E. Impulsive Phenomena of the Solar Atmosphere. I. Some Optical Events Associated with Flares Showing Explosive Phase, 935.

Atmospheric Eclipses. II (Linnell), 731.

Babcock, H. W. Topology of the Sun's Magnetic Field and the 22-Year Cycle, 572.

Balmer: Paschen Ratio in the Chromosphere and the Equilibrium Populations of Hydrogen Angular-Momentum States (House, Athay, and Zirin), 608.

Barrett, A. H. Microwave Absorption and Emission in the Atmosphere of Venus, 281.

Beard, D. B. *See* Squires and Beard.

Beardsley, W. R. Spectrum of Rho Cassiopeiae. I, 729.

Bell, G. D., and King, R. B. Absolute *f*-Value of the Pb I Line λ 2833, 718.

Billings, D. E. *See* Williamson, Fullerton, and Billings.

Boland, J. W. *See* Sloanaker and Boland.

Bonsack, W. K. Abundance of Beryllium in Four Stars of Type A, 551.

Bonsack, W. K. Abundance of Lithium in T Tauri Stars: Further Observations, 340.
Brandt, J. C. Interplanetary Gas. IV. Neutral Hydrogen in a Model Solar Corona, 688.
Brandt, J. C. Study of Comet Tails and Models of the Interplanetary Medium, 1091.
Bretz, M. C. Orbit of the Spectroscopic Binary Tau Ursae Majoris, 139.
Brooker, A. A. *See* Fernie and Brooker.
Burbidge, E. M., and Burbidge, G. R. NGC 4676, a Peculiar System in the Coma Cluster of Galaxies, 726.
Burbidge, E. M., Burbidge, G. R., and Fish, R. A. Mass of M32: A Correction, 1092.
Burbidge, E. M., Burbidge, G. R., and Fish, R. A. Masses of Elliptical Galaxies. I. A Redetermination of the Mass of M32, 393.
Burbidge, E. M., Burbidge, G. R., and Prendergast, K. H. Rotation and Mass of NGC 5005, 814.
Burbidge, G. R. *See* Burbidge and Burbidge.
Burbidge, G. R. *See* Burbidge, Burbidge, and Fish.
Burbidge, G. R. *See* Burbidge, Burbidge, and Prendergast.
Busbridge, I. W. On Inhomogeneous Stellar Atmospheres, 198.

Calculation of Pulsation Constants for the RR Lyrae Stars in M3 (Preston), 29.
Cepheids in Galactic Clusters. VII. S Nor and NGC 6087 (Fernie), 64.
Cepheids in Galactic Clusters. VIII. A Reinvestigation of U Sgr in M25 (= IC 4725) (Wampler, Pesch, Hiltner, and Kraft), 895.
Chamberlain, J. W. Interplanetary Gas. III. A Hydrodynamic Model of the Corona, 675.
Chandrasekharan, V. *See* Ch'en and Chandrasekharan.
Ch'en, S., and Chandrasekharan, V. Shift of the Absorption Lines of Fe I Due to the Presence of Helium, 1067
Clementi, E. Accurate Partition Functions in the Determination of the C_2 Abundance, 303.
Coates, R. J. Lunar Brightness Variations with Phase at 4.3-Mm Wave Length, 723.
Cohen, M. H. Microwave Polarization and Coronal Magnetic Fields, 978.
Cohen, M. H. *See* Akabane and Cohen.
Collins II, G. W., Daub, C. T., and O'Dell, C. R. Hβ and [O III] Fluxes from Planetary Nebulae. II, 471.
Color Excesses for Supergiants and Classical Cepheids. III. The Color-Magnitude Array for Cepheids in the Vicinity of the Sun (Kraft), 39.
Color Excesses for Supergiants and Classical Cepheids. IV. On Systems for Determining Color Excesses (Kraft), 57.
Color-Magnitude Diagram of 47 Tuc (Wildey), 430.
Comment on the NRL Solar Lyman-Alpha Results (Jefferies and Thomas), 606.
Comparison of Cepheids in the Small Magellanic Cloud with those in the Vicinity of the Sun (Arp and Kraft), 420.
Comparison of the Dynamic Spectra of Solar Radio Bursts in the Decimeter- and Meter-Wavelength Ranges (Kundu, Roberts, Spencer, and Kuiper), 255.
Concerning Certain Collisionless Plasma-Shock Wave Models (Noerdlinger), 1034.
Coronal Emission in the Vicinity of Quiescent Prominences (Williamson, Fullerton, and Billings), 973.
Cox, J. P., and Giuli, R. T. Equilibrium Models for Stars Which Derive Energy from Helium-burning. I. Stars Composed of Pure Helium, 755.
Cox, J. P., and Salpeter, E. E. Equilibrium Models for Stars Which Derive Energy from Helium-burning. II. Helium Stars with Hydrogen-rich Envelopes, 764.
Crawford, D. L. Hβ Photometry for the Association I Lacertae, 860.
Crawford, D. L. *See* Hardie and Crawford.

Daub, C. T. *See* Collins, Daub, and O'Dell.
Dave, J. V. *See* Sekera and Dave.
Departures from the Saha Equation for Ionized Helium. I. Condition of Detailed Balance in the Resonance Lines (Thomas and Zirker), 588.
Diffuse Transmission of Solar Ultraviolet Radiation in the Presence of Ozone (Sekera and Dave), 210.
Diffusion of Resonance Excitation through a Gas (McIntyre and Fowler), 1055.
Distinction between the Electromagnetic Constants of Tektites and Libyan Desert Glass and Their Effect on Lunar Surface Theory (Olte and Siegel), 706.
Distribution of Heights of Prominences (Ananthakrishnan), 969.
Distribution of Hydrogen in the Telluric Hydrogen Corona (Johnson), 701.
Distribution of Temperature in the Neighborhood of the Solar Limb (Pagel), 924.
Dwarf M Stars in the Pleiades (Pesch), 1085

Eddy, J. A., House, L. L., and Zirin, H. Oscillator Strength for the $3s3p^2\ ^2S\text{-}3s^2\ 3p\ ^2P$ Transition in Al I, 299.
Editorial, 1.
Emission Spectrum of RS Ophiuchi in 1958 (Joy), 493.
Equilibrium Models for Stars Which Derive Energy from Helium-burning. I. Stars Composed of Pure Helium (Cox and Giuli), 755.
Equilibrium Models for Stars Which Derive Energy from Helium-burning. II. Helium Stars with Hydrogen-rich Envelopes (Cox and Salpeter), 764.
Errata, 354, 732, 1093.
Ezer, D. Models of Massive Pure Hydrogen Stars, 159.

Feibelman, W. A. Area-Intensity Integrator for Solar Flares, 269.
Fernie, J. D. Cepheids in Galactic Clusters. VII. S Nor and NGC 6087, 64.
Fernie, J. D., and Brooker, A. A. Mass of Mira, 1088.
Fish, R. A. *See* Burbidge, Burbidge, and Fish.
Flare Activity on YZ Canis Minoris (Roques), 914.
Fowler, R. G. *See* McIntyre and Fowler.
Frequency of Binaries among Metallic-Line Stars (Abt), 730.
Fullerton, C. M. *See* Williamson, Fullerton, and Billings.

Galaxies in the Radio Source 3C 278 (Greenstein), 335.
Geometric Broadening of Stellar Spectral Lines (Huang), 130.
Gibson, J. E. Lunar Surface Characteristics Indicated by the March, 1960, Eclipse and Other Observations, 1072.
Gillett, F. *See* Ney, Huch, Kellogg, Stein, and Gillett.
Giuli, R. T. *See* Cox and Giuli.
Greenstein, J. L. Galaxies in the Radio Source 3C 278, 335.
Greenstein, J. L. *See* Oke and Greenstein.
Greenstein, J. L. *See* Parker, Greenstein, Helfer, and Wallerstein.

Hardie, R. H., and Crawford, D. L. Study of the II Scorpii Association, 843.
Hardie, R. H., and Lott, S. H. Three-Color Photometry of DY Herculis, 71.
Hβ and [O III] Fluxes from Planetary Nebulae. II (Collins, Daub, and O'Dell), 471.
Hβ Photometry for the Association I Lacertae (Crawford), 860.
Heeschen, D. S. Observations of Radio Sources at Four Frequencies, 322.
Helfer, H. L. *See* Parker, Greenstein, Helfer, and Wallerstein.

Helfer, H. L. *See* Wallerstein and Helfer.

Helliwell, T. M. Oscillator Strengths of Lead and the Lead Abundance in the Sun, 566.

Herbig, G. H. Observations of RY Tauri, 337.

Herbig, G. H. *See* Rach and Herbig.

Herdan, R., and Hughes, T. P. New Values of the Square of the Radial Integral Associated with the Dipole Matrix Elements for Transitions in Hydrogen-like Atoms, 294.

Hiltner, W. A. *See* Wampler, Pesch, Hiltner, and Kraft.

Hodge, P. W. Studies of the Large Magellanic Cloud. V. The Young Populous Clusters, 413.

House, L. L. *See* Eddy, House, and Zirin.

House, L. L., Athay, R. G., and Zirin, H. Balmer: Paschen Ratio in the Chromosphere and the Equilibrium Populations of Hydrogen Angular-Momentum States, 608.

Huang, S. Geometric Broadening of Stellar Spectral Lines, 130.

Huch, W. F. *See* Ney, Huch, Kellogg, Stein, and Gillett.

Hughes, T. P. *See* Herdan and Hughes.

Humason, M. L. *See* Zwicky and Humason.

Impulsive Phenomena of the Solar Atmosphere. I. Some Optical Events Associated with Flares Showing Explosive Phase (Athay and Moreton), 935.

Inhomogeneous Stellar Atmospheres (Busbridge), 198.

Integrated Starlight over the Sky (Roach and Megill), 228.

Interplanetary Gas. III. A Hydrodynamic Model of the Corona (Chamberlain), 675.

Interplanetary Gas. IV. Neutral Hydrogen in a Model Solar Corona (Brandt), 688.

Interpretation of the Late Main Sequence (Wilson), 457.

Interpretation of Prominence Spectra. II. The Line and Continuous Spectrum of the Spray-Type Limb Event of March 7, 1959 (Jefferies and Orrall), 946.

Interpretation of Prominence Spectra. III. The Line and Continuous Spectrum of a Loop Prominence and Limb Flare (Jefferies and Orrall), 963.

Interstellar Matter at Large Distances from the Galactic Plane (Münch and Zirin), 11.

Iriarte, B. *See* Mitchell, Johnson, and Iriarte.

Jacobsen, C. *See* Lindberg and Jacobsen.

Jefferies, J. T., and Orrall, F. Q. Interpretation of Prominence Spectra. II. The Line and Continuous Spectrum of the Spray-Type Limb Event of March 7, 1959, 946.

Jefferies, J. T., and Orrall, F. Q. Interpretation of Prominence Spectra. III. The Line and Continuous Spectrum of a Loop Prominence and Limb Flare, 963.

Jefferies, J. T., and Thomas, R. N. Comment on the NRL Solar Lyman-Alpha Results, 606.

Johnson, F. S. Distribution of Hydrogen in the Telluric Hydrogen Corona, 701.

Johnson, H. L. *See* Mitchell, Johnson, and Iriarte.

Johnson, H. M. Nucleus of M31, 309.

Johnson, H. M. Photographic Photometry of S0 Galaxies, 314.

Joy, A. H. Emission Spectrum of RS Ophiuchi in 1958, 493.

Kaftan-Kassim, M. A. Study of Neutral Hydrogen in a Region in Cygnus, 821.

Kassim, M. A. Kaftan-. *See* Kaftan-Kassim.

Kellogg, P. J. *See* Ney, Huch, Kellogg, Stein, and Gillett.

King, I. Possible Cause of Non-Randomness in Stellar Velocity Distributions, 347.

Kraft, R. P. Color Excesses for Supergiants and Classical Cepheids. III. The Color-Magnitude Array for Cepheids in the Vicinity of the Sun, 39.

Kraft, R. P. Color Excesses for Supergiants and Classical Cepheids. IV. On Systems for Determining Color Excesses, 57.

Kraft, R. P. *See* Arp and Kraft.
Kraft, R. P. *See* Wampler, Pesch, Hiltner, and Kraft.
Kuiper, G. P. Micrometer Measures of Double Stars, 730.
Kuiper, J. W. *See* Kundu, Roberts, Spencer, and Kuiper.
Kundu, M. R., Roberts, J. A., Spencer, C. L., and Kuiper, J. W. Comparison of the Dynamic Spectra of Solar Radio Bursts in the Decimeter- and Meter-Wave-Length Ranges, 255.

Ledoux, P., Schwarzschild, M., and Spiegel, E. A. On the Spectrum of Turbulent Convection, 184.
Light and Radial-Velocity Variations of TU Ursae Majoris (Preston, Spinrad, and Varsavsky), 484.
Lindberg, L., and Jacobsen, C. Amplification of the Poloidal Magnetic Flux in a Plasma, 1043.
Linnell, A. P. Atmospheric Eclipses. II, 731.
Lott, S. H. *See* Hardie and Lott.
Lunar Brightness Variations with Phase at 4.3-Mm Wave Length (Coates), 723.
Lunar Surface Characteristics Indicated by the March, 1960, Eclipse and Other Observations (Gibson), 1072.

McIntyre, R. G., and Fowler, R. G. Diffusion of Resonance Excitation through a Gas, 1055.
Magnetic-Field Intensity in the Galaxy (Woltjer), 352.
Mass of M32: A Correction (Burbidge, Burbidge, and Fish), 1092.
Mass of Mira (Fernie and Brooker), 1088.
Masses of Elliptical Galaxies. I. A Redetermination of the Mass of M32 (Burbidge, Burbidge, and Fish), 393.
Matter, Anti-Matter, and Gravitation (Swann), 733.
Meadows, A. J. Rotational Velocities of Stars in M39 and the Ursa Major Cluster, 907.
Megill, L. R. *See* Roach and Megill.
Merrill, P. W. Spectrum of XX Ophiuchi in 1959 and 1960, 503.
Michie, R. W. Structure and Evolution of Globular Clusters, 781.
Micrometer Measures of Double Stars (Kuiper), 730.
Microwave Absorption and Emission in the Atmosphere of Venus (Barrett), 281.
Microwave Polarization and Coronal Magnetic Fields (Cohen), 978.
Mitchell, R. I. NGC 6639 and Cepheid X Sct, 728.
Mitchell, R. I., Johnson, H. L., and Iriarte, B. *U*, *B*, *V*, Observations of U Sgr, 1083.
Model for Helium Star of 1 Solar Mass (Oke), 166.
Models of Massive Pure Hydrogen Stars (Ezer), 159.
Moreton, G. E. *See* Athay and Moreton.
Moreton, G. E. *See* Young, Spencer, Moreton, and Roberts.
Morton, D. C., and Widing, K. G. Solar Lyman-Alpha Emission Line, 596.
Münch, G., and Zirin, H. Interstellar Matter at Large Distances from the Galactic Plane, 11.

Nassau, J. J., and Stephenson, C. B. Spectral Classifications for New or Unclassified Emission-Line, Carbon and S, Long-Period Variable, and Double Stars, 920.
New Values of the Square of the Radial Integral Associated with the Dipole Matrix Elements for Transitions in Hydrogen-like Atoms (Herdan and Hughes), 294.
Newkirk, Jr., G. Solar Corona in Active Regions and the Thermal Origin of the Slowly Varying Component of Solar Radio Radiation, 983.
Ney, E. P., Huch, W. F., Kellogg, P. J., Stein, W., and Gillett, F. Polarization and Intensity Studies of the Eclipse of October 2, 1959, 616.

NGC 4676, a Peculiar System in the Coma Cluster of Galaxies (Burbidge and Burbidge), 726.
NGC 6639 and Cepheid X Sct (Mitchell), 728.
Noerdlinger, P. D. Concerning Certain Collisionless Plasma-Shock Wave Models, 1034.
Note on the Spectral Types of Faint Stars in NGC 6530 (Walker), 1081.
Nucleus of M31 (Johnson), 309.

Observations of Jupiter at a Wave Length of 10 Cm (Sloanaker and Boland), 649.
Observations of Radio Sources at Four Frequencies (Heeschen), 322.
Observations of RY Tauri (Herbig), 337.
O'Dell, C. R. *See* Collins, Daub, and O'Dell.
Oke, J. B. Analysis of the Absolute Energy Distribution in the Spectrum of Eta Aquilae, 90.
Oke, J. B. Model for a Helium Star of 1 Solar Mass, 166.
Oke, J. B., and Greenstein, J. L. Photoelectric Scanning of Spectral Lines, 349.
Olte, A., and Siegel, K. M. Distinction between the Electromagnetic Constants of Tektites and Libyan Desert Glass and Their Effect on Lunar Surface Theory, 706.
Orbit of the Spectroscopic Binary Phi Cygni (Rach and Herbig), 143.
Orbit of the Spectroscopic Binary Tau Ursae Majoris (Bretz), 139.
Origin of Cosmic Magnetic Fields (Alfvén), 1049.
Orrall, F. Q. *See* Jefferies and Orrall.
Oscillator Strength for the $3s3p^2\ ^2S\text{-}3s^2\ 3p\ ^2P$ Transition in Al I (Eddy, House, and Zirin), 299.
Oscillator Strengths of Lead and the Lead Abundance in the Sun (Helliwell), 566.
Osterbrock, D. E., and Stockhausen, R. E. Photometry and Radiometry of Gaseous Nebulae, 2.

Pagel, B. E. J. Distribution of Temperature in the Neighborhood of the Solar Limb, 924.
Parker, E. N. Sudden Expansion of the Corona Following a Large Solar Flare and the Attendant Magnetic Field and Cosmic-Ray Effects, 1014.
Parker, R., Greenstein, J. L., Helfer, H. L., and Wallerstein, G. Abundances in G Dwarf Stars. IV. A Redetermination of the Abundances in G Dwarfs in the Hyades, 101.
Periods of Long-Period Variables in Globular Clusters (Stothers and Schwarzschild), 343.
Pesch, P. Dwarf M Stars in the Pleiades, 1085.
Pesch, P. *See* Wampler, Pesch, Hiltner, and Kraft.
Peterson, A. W. Three-Color Photometry of the Zodiacal Light, 668.
Photoelectric Scanning of Spectral Lines (Oke and Greenstein), 349.
Photographic Photometry of S0 Galaxies (Johnson), 314.
Photometry and Radiometry of Gaseous Nebulae (Osterbrock and Stockhausen), 2.
Physical Atmospheric Parameters for Late-Type Stars (Vardya), 107.
Physical and Orbital Behavior of Comets (Squires and Beard), 657.
Polarization and Intensity Studies of the Eclipse of October 2, 1959 (Ney, Huch, Kellogg, Stein, and Gillett), 616.
Polarization Measurements of Type III Bursts and Faraday Rotation in the Corona (Akabane and Cohen), 258.
Popper, D. M. Rediscussion of Eclipsing Binaries. V. RS Canum Venaticorum, 148.
Possible Cause of Non-Randomness in Stellar Velocity Distributions (King), 347.
Preliminary Study of the Dynamic Spectra of Solar Radio Bursts in the Frequency Range 500–950 Mc/s (Young, Spencer, Moreton, and Roberts), 243.
Prendergast, K. H. *See* Burbidge, Burbidge, and Prendergast.
Preston, G. W. Calculation of Pulsation Constants for the RR Lyrae Stars, 29.
Preston, G. W., Spinrad, H., and Varsavsky, C. M. Light and Radial-Velocity Variations of TU Ursae Majoris, 484.

Rach, R. A., and Herbig, G. H. Orbit of the Spectroscopic Binary Phi Cygni, 143.
Radial Velocities of Three Metallic-Line Stars (Abt), 910.
Radial Velocity of Sigma Scorpii (Struve, Sahade, and Zebergs), 509.
Rediscussion of Eclipsing Binaries. V. RS Canum Venaticorum (Popper), 148.
Roach, F. E., and Megill, L. R. Integrated Starlight over the Sky, 228.
Roberts, J. A. *See* Kundu, Roberts, Spencer, and Kuiper.
Roberts, J. A. *See* Young, Spencer, Moreton, and Roberts.
Roques, P. E. Flare Activity on YZ Canis Minoris, 914.
Rotation and Mass of NGC 5005 (Burbidge, Burbidge, and Prendergast), 814.
Rotational Velocities of Stars in M39 and the Ursa Major Cluster (Meadows), 907.

Sahade, J. *See* Struve, Sahade, and Zebergs.
Salpeter, E. E. *See* Cox and Salpeter.
Sandage, A. Ability of the 200-Inch Telescope To Discriminate between Selected World Models, 355.
Schwarzschild, M. *See* Ledoux, Schwarzschild, and Spiegel.
Schwarzschild, M. *See* Stothers and Schwarzschild.
Searle, L. Abundance Analysis of R Coronae Borealis, 531.
Sekera, Z., and Dave, J. V. Diffuse Transmission of Solar Ultraviolet Radiation in the Presence of Ozone, 210.
Shape of Magnetic Stars (Wentzel), 170.
Shift of the Absorption Lines of Fe I Due to the Presence of Helium (Ch'en and Chandrasekharan), 1067.
Siegel, K. M. *See* Olte and Siegel.
Sloanaker, R. M., and Boland, J. W. Observations of Jupiter at a Wave Length of 10 Cm, 649.
Solar Corona in Active Regions and the Thermal Origin of the Slowly Varying Component of Solar Radio Radiation (Newkirk), 983.
Solar Lyman-Alpha Emission Line (Morton and Widing), 596.
Some Atomic Parameters for Ultraviolet Lines (Varsavsky), 730.
Southern Galaxies. I. Luminosity, Rotation, and Mass of the Magellanic System NGC 55 (de Vaucouleurs), 405.
Spectra and other Characteristics of Interconnected Galaxies and of Galaxies in Groups and in Clusters. II (Zwicky and Humason), 794.
Spectral Classifications for New or Unclassified Emission-Line, Carbon and S, Long-Period Variable, and Double Stars (Nassau and Stephenson), 920.
Spectral Observations of Solar Radio Bursts. I. Receiving Equipment (Thompson), 643.
Spectrum of the B8 Component of Beta Lyrae (Struve and Zebergs), 519.
Spectrum of Rho Cassiopeiae. I (Beardsley), 729.
Spectrum of Turbulent Convection (Ledoux, Schwarzschild, and Spiegel), 184.
Spectrum of XX Ophiuchi in 1959 and 1960 (Merrill), 503.
Spencer, C. L. *See* Kundu, Roberts, Spencer, and Kuiper.
Spencer, C. L. *See* Young, Spencer, Moreton, and Roberts.
Spiegel, E. A. *See* Ledoux, Schwarzschild, and Spiegel.
Spinrad, H. SU Draconis and Line Blanketing in the RR Lyrae Stars, 479.
Spinrad, H. *See* Preston, Spinrad, and Varsavsky.
Squires, R. E., and Beard, D. B. Physical and Orbital Behavior of Comets, 657.
Stein, W. *See* Ney, Huch, Kellogg, Stein, and Gillett.
Stephenson, C. B. *See* Nassau and Stephenson.
Stockhausen, R. E. *See* Osterbrock and Stockhausen.

Stothers, R. B., and Schwarzschild, M. Periods of Long-Period Variables in Globular Clusters, 343.

Structure and Evolution of Globular Clusters (Michie), 781.

Struve, O., Sahade, J., and Zebergs, V. Radial Velocity of Sigma Scorpii, 509.

Struve, O., and Zebergs, V. Spectrum of the B8 Component of Beta Lyrae, 519.

Studies of Extremely Young Clusters. IV. NGC 6611 (Walker), 438.

Studies of the Large Magellanic Cloud. V. The Young Populous Clusters (Hodge), 413.

Study of Comet Tails and Models of the Interplanetary Medium (Brandt), 1091.

Study of Neutral Hydrogen in a Region in Cygnus (Kaftan-Kassim), 821.

Study of the II Scorpii Association (Hardie and Crawford), 843.

SU Draconis and Line Blanketing in the RR Lyrae Stars (Spinrad), 479.

Sudden Expansion of the Corona Following a Large Solar Flare and the Attendant Magnetic Field and Cosmic-Ray Effects (Parker), 1014.

Supernova in NGC 7331 (Arp), 883.

Swann, W. F. G. An Analysis of R. A. Lyttleton and H. Bondi's Theory of "The Physical Consequences of a General Excess of Charge," 738.

Swann, W. F. G. Matter, Anti-Matter, and Gravitation, 733.

Thermal Budget of the Planet Mercury (Walker), 274.

Thomas, R. N. *See* Jefferies and Thomas.

Thomas, R. N., and Zirker, J. B. Departures from the Saha Equation for Ionized Helium. I. Condition of Detailed Balance in the Resonance Lines, 588.

Thompson, A. R. Spectral Observations of Solar Radio Bursts. I. Receiving Equipment, 643.

Three-Color Photometry of DY Herculis (Hardie and Lott), 71.

Three-Color Photometry of the Zodiacal Light (Peterson), 668.

Topology of the Sun's Magnetic Field and the 22-Year Cycle (Babcock), 572.

Transformation of Photographic Magnitudes (Arp), 869.

$U - B$ and $B - V$ Colors of Black Bodies (Arp), 874.

U, B, V, Observations of U Sgr (Mitchell, Johnson, and Iriarte), 1083.

Vardya, M. S. Physical Atmospheric Parameters for Late-Type Stars, 107.

Varsavsky, C. M. Some Atomic Parameters for Ultraviolet Lines, 730.

Varsavsky, C. M. *See* Preston, Spinrad, and Varsavsky.

Vaucouleurs, G. de. Southern Galaxies. I. Luminosity, Rotation, and Mass of the Magellanic System NGC 55, 405.

Walker, J. C. G. Thermal Budget of the Planet Mercury, 274.

Walker, M. F. Note on the Spectral Types of Faint Stars in NGC 6530, 1081.

Walker, M. F. Studies of Extremely Young Clusters. IV. NGC 6611, 438.

Wallerstein, G. *See* Parker, Greenstein, Helfer, and Wallerstein.

Wallerstein, G., and Helfer, H. L. Abundances in G Dwarfs. V. The Metal-rich Star 20 Leo Minoris and Two Comparison Stars, 562.

Wampler, J., Pesch, P., Hiltner, W. A., and Kraft, R. P. Cepheids in Galactic Clusters. VIII. A Reinvestigation of U Sgr in M25 (= IC 4725), 895.

Wentzel, D. G. On the Shape of Magnetic Stars, 170.

Widing, K. G. *See* Morton and Widing.

Wildey, R. L. Color-Magnitude Diagram of 47 Tuc, 430.

Williamson, N. K., Fullerton, C. M., and Billings, D. E. Coronal Emission in the Vicinity of Quiescent Prominences, 973.

Wilson, O. C. Interpretation of the Late Main Sequence, 457.

Woltjer, L. Magnetic-Field Intensity in the Galaxy, 352.

Young, C. W., Spencer, C. L., Moreton, G. E., and Roberts, J. A. Preliminary Study of the Dynamic Spectra of Solar Radio Bursts in the Frequency Range 500–950 Mc/s, 243.

Zebergs, V. *See* Struve and Zebergs.

Zebergs, V. *See* Struve, Sahade, and Zebergs.

Zirin, H. *See* Eddy, House, and Zirin.

Zirin, H. *See* House, Athay, and Zirin.

Zirin, H. *See* Münch and Zirin.

Zirker, J. B. *See* Thomas and Zirker.

Zwicky, F., and Humason, M. L. Spectra and other Characteristics of Interconnected Galaxies and of Galaxies in Groups and in Clusters. II, 794.

THE ASTROPHYSICAL JOURNAL

An International Review of Spectroscopy and Astronomical Physics

FOUNDED IN 1895 BY GEORGE E. HALE AND JAMES E. KEELER

Published in Collaboration with the American Astronomical Society

S. CHANDRASEKHAR
Managing Editor

JOSEPH W. CHAMBERLAIN
Associate Editor

Yerkes Observatory of the University of Chicago

EDITORIAL BOARD

GEORGE H. HERBIG (1961–65)
Lick Observatory

GEOFFREY KELLER (1959–63)
National Science Foundation

RUPERT WILDT (1960–64)
Yale University Observatory

OLIN C. WILSON (1958–62)
Mount Wilson and Palomar Observatories

ROBERT M. PETRIE (1960–61)
Dominion Astrophysical Observatory
Victoria, B.C., Canada

VOLUME 133

JANUARY–MAY 1961

THE UNIVERSITY OF CHICAGO PRESS
CHICAGO, ILLINOIS

COPYRIGHT 1961 BY THE UNIVERSITY OF CHICAGO

PUBLISHED JANUARY, MARCH, MAY 1961

COMPOSED AND PRINTED BY THE UNIVERSITY OF CHICAGO PRESS
CHICAGO, ILLINOIS, U.S.A.

CONTENTS

NUMBER 1

EDITORIAL 1

PHOTOMETRY AND RADIOMETRY OF GASEOUS NEBULAE. Donald E. Osterbrock and Ralph E. Stockhausen 2

INTERSTELLAR MATTER AT LARGE DISTANCES FROM THE GALACTIC PLANE. Guido Münch and Harold Zirin 11

THE CALCULATION OF PULSATION CONSTANTS FOR THE RR LYRAE STARS IN M3. George Preston 29

COLOR EXCESSES FOR SUPERGIANTS AND CLASSICAL CEPHEIDS. III. THE COLOR-MAGNITUDE ARRAY FOR CEPHEIDS IN THE VICINITY OF THE SUN. Robert P. Kraft . . . 39

COLOR EXCESSES FOR SUPERGIANTS AND CLASSICAL CEPHEIDS. IV. ON SYSTEMS FOR DETERMINING COLOR EXCESSES. Robert P. Kraft 57

CEPHEIDS IN GALACTIC CLUSTERS. VII. S NOR AND NGC 6087. J. D. Fernie . . . 64

THREE-COLOR PHOTOMETRY OF DY HERCULIS. R. H. Hardie and S. H. Lott . . . 71

AN ANALYSIS OF THE ABSOLUTE ENERGY DISTRIBUTION IN THE SPECTRUM OF ETA AQUILAE. J. B. Oke 90

ABUNDANCES IN G DWARF STARS. IV. A REDETERMINATION OF THE ABUNDANCES IN G DWARFS IN THE HYADES. Robert Parker, Jesse L. Greenstein, H. L. Helfer, and George Wallerstein 101

PHYSICAL ATMOSPHERIC PARAMETERS FOR LATE-TYPE STARS. M. S. Vardya 107

GEOMETRIC BROADENING OF STELLAR SPECTRAL LINES. Su-Shu Huang 130

THE ORBIT OF THE SPECTROSCOPIC BINARY TAU URSAE MAJORIS. Marianne C. Bretz . 139

THE ORBIT OF THE SPECTROSCOPIC BINARY PHI CYGNI. R. A. Rach and G. H. Herbig . 143

REDISCUSSION OF ECLIPSING BINARIES. V. RS CANUM VENATICORUM. Daniel M. Popper 148

MODELS OF MASSIVE PURE HYDROGEN STARS. Dilhan Ezer 159

MODEL FOR A HELIUM STAR OF 1 SOLAR MASS. J. B. Oke 166

ON THE SHAPE OF MAGNETIC STARS. Donat G. Wentzel 170

ON THE SPECTRUM OF TURBULENT CONVECTION. P. Ledoux, M. Schwarzschild, and E. A. Spiegel 184

ON INHOMOGENEOUS STELLAR ATMOSPHERES. I. W. Busbridge 198

DIFFUSE TRANSMISSION OF SOLAR ULTRAVIOLET RADIATION IN THE PRESENCE OF OZONE. Z. Sekera and J. V. Dave 210

INTEGRATED STARLIGHT OVER THE SKY. F. E. Roach and Lawrence R. Megill . . . 228

A PRELIMINARY STUDY OF THE DYNAMIC SPECTRA OF SOLAR RADIO BURSTS IN THE FREQUENCY RANGE 500–950 Mc/s. C. W. Young, C. L. Spencer, G. E. Moreton, and J. A. Roberts 243

A COMPARISON OF THE DYNAMIC SPECTRA OF SOLAR RADIO BURSTS IN THE DECIMETER- AND METER-WAVE-LENGTH RANGES. M. R. Kundu, J. A. Roberts, C. L. Spencer, and J. W. Kuiper 255

Polarization Measurements of Type III Bursts and Faraday Rotation in the Corona. K. Akabane and M. H. Cohen 258

Area-Intensity Integrator for Solar Flares. W. A. Feibelman 269

The Thermal Budget of the Planet Mercury. J. C. G. Walker 274

Microwave Absorption and Emission in the Atmosphere of Venus. Alan H. Barrett 281

New Values of the Square of the Radial Integral Associated with the Dipole Matrix Elements for Transitions in Hydrogen-like Atoms. R. Herdan and T. P. Hughes 294

Oscillator Strength for the $3s3p^2\ ^2S$-$3s^2\ 3p^2P$ Transition in Al I. John A. Eddy, Lewis L. House, and Harold Zirin 299

Accurate Partition Functions in the Determination of the C_2 Abundance. Enrico Clementi 303

The Nucleus of M31. Hugh M. Johnson 309

Photographic Photometry of S0 Galaxies. Hugh M. Johnson 314

Observations of Radio Sources at Four Frequencies. D. S. Heeschen 322

Notes

The Galaxies in the Radio Source 3C 278. Jesse L. Greenstein 335

Observations of RY Tauri. G. H. Herbig 337

The Abundance of Lithium in T Tauri Stars: Further Observations. Walter K. Bonsack 340

On the Periods of Long-Period Variables in Globular Clusters. Richard B. Stothers and M. Schwarzschild 343

Letters to the Editor

A Possible Cause of Non-Randomness in Stellar Velocity Distributions. Ivan King 347

Photoelectric Scanning of Spectral Lines. J. B. Oke and Jesse L. Greenstein . 349

The Magnetic-Field Intensity in the Galaxy. L. Woltjer 352

Errata 354

NUMBER 2

The Ability of the 200-Inch Telescope To Discriminate between Selected World Models. Allan Sandage 355

The Masses of Elliptical Galaxies. I. A Redetermination of the Mass of M32. E. Margaret Burbidge, G. R. Burbidge, and R. A. Fish 393

Southern Galaxies. I. Luminosity, Rotation, and Mass of the Magellanic System NGC 55. Gerard de Vaucouleurs 405

Studies of the Large Magellanic Cloud. V. The Young Populous Clusters. Paul W. Hodge 413

A Comparison of Cepheids in the Small Magellanic Cloud with Those in the Vicinity of the Sun. Halton C. Arp and Robert P. Kraft 420

The Color-Magnitude Diagram of 47 Tuc. Robert L. Wildey 430

Studies of Extremely Young Clusters. IV. NGC 6611. Merle F. Walker . . . 438

An Interpretation of the Late Main Sequence. O. C. Wilson 457

Hβ and [O III] Fluxes from Planetary Nebulae. II. G. W. Collins II, C. T. Daub, and C. R. O'Dell 471

SU Draconis and Line Blanketing in the RR Lyrae Stars. Hyron Spinrad . . 479

The Light and Radial-Velocity Variations of TU Ursae Majoris. George W. Preston, Hyron Spinrad, and Carlos M. Varsavsky 484

The Emission Spectrum of RS Ophiuchi in 1958. Alfred H. Joy 493

The Spectrum of XX Ophiuchi in 1959 and 1960. Paul W. Merrill 503

The Radial Velocity of Sigma Scorpii. O. Struve, J. Sahade, and V. Zebergs . . 509

The Spectrum of the B8 Component of Beta Lyrae. O. Struve and V. Zebergs . 519

An Abundance Analysis of R Coronae Borealis. Leonard Searle 531

The Abundance of Beryllium in Four Stars of Type A. Walter K. Bonsack . . 551

Abundances in G Dwarfs. V. The Metal-rich Star 20 Leo Minoris and Two Comparison Stars. George Wallerstein and H. L. Helfer 562

Oscillator Strengths of Lead and the Lead Abundance in the Sun. T. M. Helliwell 566

The Topology of the Sun's Magnetic Field and the 22-Year Cycle. H. W. Babcock 572

Departures from the Saha Equation for Ionized Helium. I. Condition of Detailed Balance in the Resonance Lines. Richard N. Thomas and J. B. Zirker . 588

The Solar Lyman-Alpha Emission Line. Donald C. Morton and Kenneth G. Widing 596

A Comment of the NRL Solar Lyman-Alpha Results. J. T. Jefferies and R. N. Thomas 606

The Balmer: Paschen Ratio in the Chromosphere and the Equilibrium Populations of Hydrogen Angular-Momentum States. Lewis L. House, R. Grant Athay, and Harold Zirin 608

Polarization and Intensity Studies of the Eclipse of October 2, 1959. E. P. Ney, W. F. Huch, P. J. Kellogg, W. Stein, and F. Gillett 616

Spectral Observations of Solar Radio Bursts. I. Receiving Equipment. A. R. Thompson 643

Observations of Jupiter at a Wave Length of 10 Cm. Russell M. Sloanaker and John W. Boland 649

Physical and Orbital Behavior of Comets. Roy E. Squires and David B. Beard . 657

Three-Color Photometry of the Zodiacal Light. Alan W. Peterson 668

Interplanetary Gas. III. A Hydrodynamic Model of the Corona. Joseph W. Chamberlain 675

Interplanetary Gas. IV. Neutral Hydrogen in a Model Solar Corona. John C. Brandt 688

The Distribution of Hydrogen in the Telluric Hydrogen Corona. Francis S. Johnson 701

Distinction between the Electromagnetic Constants of Tektites and Libyan Desert Glass and Their Effect on Lunar Surface Theory. A. Olte and K. M. Siegel 706

The Absolute *f*-Value of the Pb I Line λ 2833. G. D. Bell and R. B. King . . . 718

Notes

Lunar Brightness Variations with Phase at 4.3-Mm Wave Length. Robert J. Coates 723

Letters to the Editor

NGC 4676, a Peculiar System in the Coma Cluster of Galaxies. E. M. Burbidge and G. R. Burbidge 726

NGC 6639 and Cepheid X Sct. Richard I. Mitchell 728

ABSTRACTS OF ASTROPHYSICAL JOURNAL SUPPLEMENT SERIES

THE SPECTRUM OF RHO CASSIOPEIAE. I. Wallace R. Beardsley 729
MICROMETER MEASURES OF DOUBLE STARS. Gerard P. Kuiper 730
THE FREQUENCY OF BINARIES AMONG METALLIC-LINE STARS. Helmut A. Abt . . 730
SOME ATOMIC PARAMETERS FOR ULTRAVIOLET LINES. Carlos M. Varsavsky . . . 730
ATMOSPHERIC ECLIPSES. II. Albert P. Linnell 731

ERRATA 732

NUMBER 3

MATTER, ANTI-MATTER, AND GRAVITATION. W. F. G. Swann 733

AN ANALYSIS OF R. A. LYTTLETON AND H. BONDI'S THEORY OF "THE PHYSICAL CONSEQUENCES OF A GENERAL EXCESS OF CHARGE." W. F. G. Swann 738

EQUILIBRIUM MODELS FOR STARS WHICH DERIVE ENERGY FROM HELIUM-BURNING. I. STARS COMPOSED OF PURE HELIUM. John P. Cox and R. Thomas Giuli 755

EQUILIBRIUM MODELS FOR STARS WHICH DERIVE ENERGY FROM HELIUM-BURNING. II. HELIUM STARS WITH HYDROGEN-RICH ENVELOPES. John P. Cox and Edwin E. Salpeter 764

STRUCTURE AND EVOLUTION OF GLOBULAR CLUSTERS. Richard W. Michie 781

SPECTRA AND OTHER CHARACTERISTICS OF INTERCONNECTED GALAXIES AND OF GALAXIES IN GROUPS AND IN CLUSTERS. II. F. Zwicky and M. L. Humason 794

THE ROTATION AND MASS OF NGC 5005. E. Margaret Burbidge, G. R. Burbidge, and K. H. Prendergast 814

A STUDY OF NEUTRAL HYDROGEN IN A REGION IN CYGNUS. May A. Kaftan-Kassim . 821

A STUDY OF THE II SCORPII ASSOCIATION. R. H. Hardie and D. L. Crawford . . . 843

$H\beta$ PHOTOMETRY FOR THE ASSOCIATION I LACERTAE. D. L. Crawford 860

TRANSFORMATION OF PHOTOGRAPHIC MAGNITUDES. Halton Arp 869

$U - B$ AND $B - V$ COLORS OF BLACK BODIES. Halton Arp 874

SUPERNOVA IN NGC 7331. Halton Arp 883

CEPHEIDS IN GALACTIC CLUSTERS. VIII. A REINVESTIGATION OF U SGR IN M25 (= IC 4725). J. Wampler, Peter Pesch, W. A. Hiltner, and Robert P. Kraft 895

ROTATIONAL VELOCITIES OF STARS IN M39 AND THE URSA MAJOR CLUSTER. A. J. Meadows 907

RADIAL VELOCITIES OF THREE METALLIC-LINE STARS. Helmut A. Abt 910

FLARE ACTIVITY ON YZ CANIS MINORIS. Paul E. Roques 914

SPECTRAL CLASSIFICATIONS FOR NEW OR UNCLASSIFIED EMISSION-LINE, CARBON AND S, LONG-PERIOD VARIABLE, AND DOUBLE STARS. J. J. Nassau and C. B. Stephenson . 920

THE DISTRIBUTION OF TEMPERATURE IN THE NEIGHBORHOOD OF THE SOLAR LIMB. B. E. J. Pagel 924

IMPULSIVE PHENOMENA OF THE SOLAR ATMOSPHERE. I. SOME OPTICAL EVENTS ASSOCIATED WITH FLARES SHOWING EXPLOSIVE PHASE. R. Grant Athay and G. E. Moreton 935

ON THE INTERPRETATION OF PROMINENCE SPECTRA. II. THE LINE AND CONTINUOUS SPECTRUM OF THE SPRAY-TYPE LIMB EVENT OF MARCH 7, 1959. J. T. Jefferies and F. Q. Orrall 946

ON THE INTERPRETATION OF PROMINENCE SPECTRA. III. THE LINE AND CONTINUOUS SPECTRUM OF A LOOP PROMINENCE AND LIMB FLARE. J. T. Jefferies and F. Q. Orrall 963

DISTRIBUTION OF HEIGHTS OF PROMINENCES. R. Ananthakrishnan 969

Coronal Emission in the Vicinity of Quiescent Prominences. N. K. Williamson, C. M. Fullerton, and D. E. Billings 973

Microwave Polarization and Coronal Magnetic Fields. Marshall H. Cohen . . 978

The Solar Corona in Active Regions and the Thermal Origin of the Slowly Varying Component of Solar Radio Radiation. Gordon Newkirk, Jr. 983

Sudden Expansion of the Corona Following a Large Solar Flare and the Attendant Magnetic Field and Cosmic-Ray Effects. E. N. Parker 1014

Concerning Certain Collisionless Plasma-Shock Wave Models. Peter D. Noerdlinger 1034

On the Amplification of the Poloidal Magnetic Flux in a Plasma. L. Lindberg and C. Jacobsen 1043

On the Origin of Cosmic Magnetic Fields. H. Alfvén 1049

The Diffusion of Resonance Excitation through a Gas. R. G. McIntyre and R. G. Fowler 1055

The Shift of the Absorption Lines of Fe I Due to the Presence of Helium. Shang-Yi Ch'en and V. Chandrasekharan 1067

Lunar Surface Characteristics Indicated by the March, 1960, Eclipse and Other Observations. J. E. Gibson 1072

Notes

A Note on the Spectral Types of Faint Stars in NGC 6530. Merle F. Walker . 1081

U, *B*, *V*, Observations of U Sgr. Richard I. Mitchell, Harold L. Johnson, and Braulio Iriarte 1083

Dwarf M Stars in the Pleiades. Peter Pesch 1085

The Mass of Mira. J. D. Fernie and A. A. Brooker 1088

Letters to the Editor

On the Study of Comet Tails and Models of the Interplanetary Medium. John C. Brandt 1091

The Mass of M32: A Correction. E. M. Burbidge, G. R. Burbidge, and R. A. Fish 1092

Errata 1093